MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2018/2019

EME1026 – FLUID MECHANICS

(ME)

24 OCTOBER 2018
2:30 p.m – 4:30 p.m
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 7 pages with 4 Questions only.

2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please write all your answers in the Answer Booklet provided.

Question 1

Figure Q1 shows a closed tank of 1.2 m width and 1.2 m height. The tank is filled with water and has a 1.0 m diameter hemispherical dome. A U-tube manometer is connected to the tank. The air pressure at the upper end of the manometer is 90 kPa. The specific weight of water is 9810 N/m^3 while the specific gravity of the gage fluid is 3.0.

(a) Determine the gage pressure reading on the pressure gage. **[5 marks]**

(b) Determine the resultant hydrostatic force acting on the left wall of the tank, by using the following methods:

(i) The hydrostatic force equation
(ii) The pressure prism (Sketch the pressure prism)

Prove that both methods yield the same solution. **[9 marks]**

(c) Determine the vertical force exerted by the water on the dome.
Hints: A free body diagram sketch would be useful. **[7 marks]**

(d) If the upper end of the manometer is now exposed to the atmosphere, and the differential manometer reading and the pressure gage reading are still the same as before, what is the specific gravity of the gage fluid? **[4 marks]**

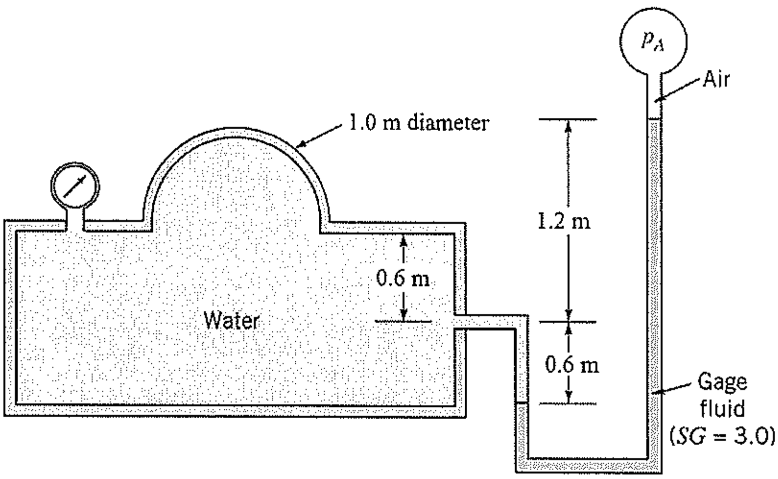

Figure Q1

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Question 2

Water flows into the atmosphere from a nozzle and strikes a vertical plate as shown in Figure Q2. A horizontal force of 10 N is required to hold the plate in place. Assume the flow to be incompressible and frictionless. The density of water is 998.2 kg/m^3 and gravity effect is negligible.

(a) Determine the inlet and outlet velocities of the nozzle. **[9 marks]**

(b) Determine the pressure gage reading. **[6 marks]**

(c) If the water mass flow rate is doubled,

(i) What is the minimum horizontal force required to hold the plate in place?

(ii) Is there any changes to the reading of the pressure gage?

Please justify your answer with proper calculations. **[10 marks]**

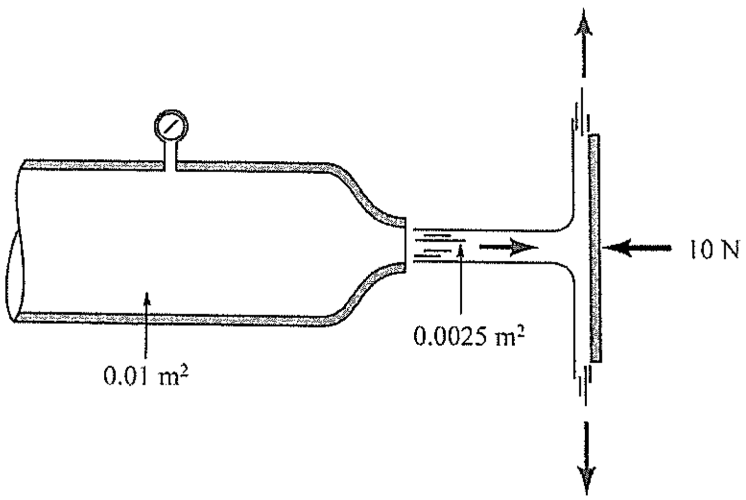

Figure Q2

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Question 3

A cylinder with a diameter D, floats upright in a liquid as shown in Figure Q3. When the cylinder is displaced slightly along its vertical axis, it will oscillate about its equilibrium position with a frequency, ω. Assume that this frequency is a function of the diameter, D, the mass of the cylinder, m, and the specific weight, γ, of the liquid. With the aid of dimensional analysis, solve the following questions in sequence.

(a) List all the variables that are involved in the problem. **[3 marks]**

(b) Express each of the variables in term of basic dimension using *FLT* system. **[4 marks]**

(c) Determine the required number of pi terms. **[3 marks]**

(d) Form the pi term by inspection using *FLT* system. **[3 marks]**

(e) Check the resulting pi term using *MLT* system. **[3 marks]**

(f) How is the frequency related to these variables? **[6 marks]**

(g) If the mass of the cylinder were increased, would the frequency increase or decrease? **[3 marks]**

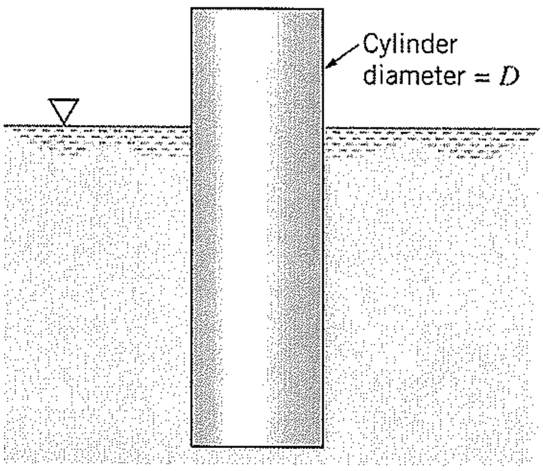

Figure Q3

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Question 4

(a) Air flows through the fine mesh gauze shown in Figure Q4a with an average velocity of 1.5 m/s in the pipe with 2 cm pipe diameter. The density of air and water are 1.23 kg/m^3 and 997 kg/m^3, respectively. The dynamics viscosity of air is 1.78 x 10-5 kg/m.s.

(i) Form an energy equation with the guided point (1) and point (2) as illustrated in Figure Q4a. **[4 marks]**

(ii) Determine the pressure at point (1) and point (2). **[4 marks]**

(iii) Determine the Reynolds number at point (1). **[2 marks]**

(iv) Determine the loss coefficient for the gauze. **[2.5 marks]**

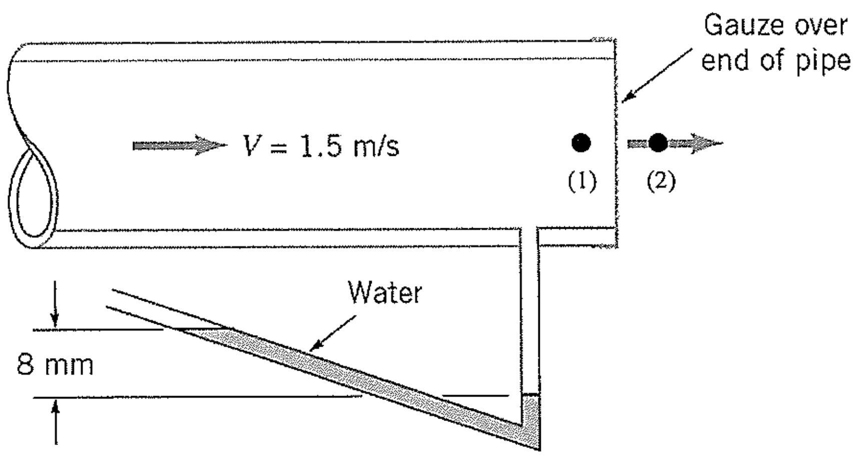

Figure Q4a

(b) A centrifugal pump with a 30 cm diameter impeller requires a power input of 45 kW when the flow rate is 12 kL/min against an 18 m head. The impeller is changed to one with a 25 cm diameter. Determine

(i) The expected flow rate. **[5 marks]**

(ii) Actual head. **[4 marks]**

(iii) Input power if the pump speed remains the same. **[3.5 marks]**

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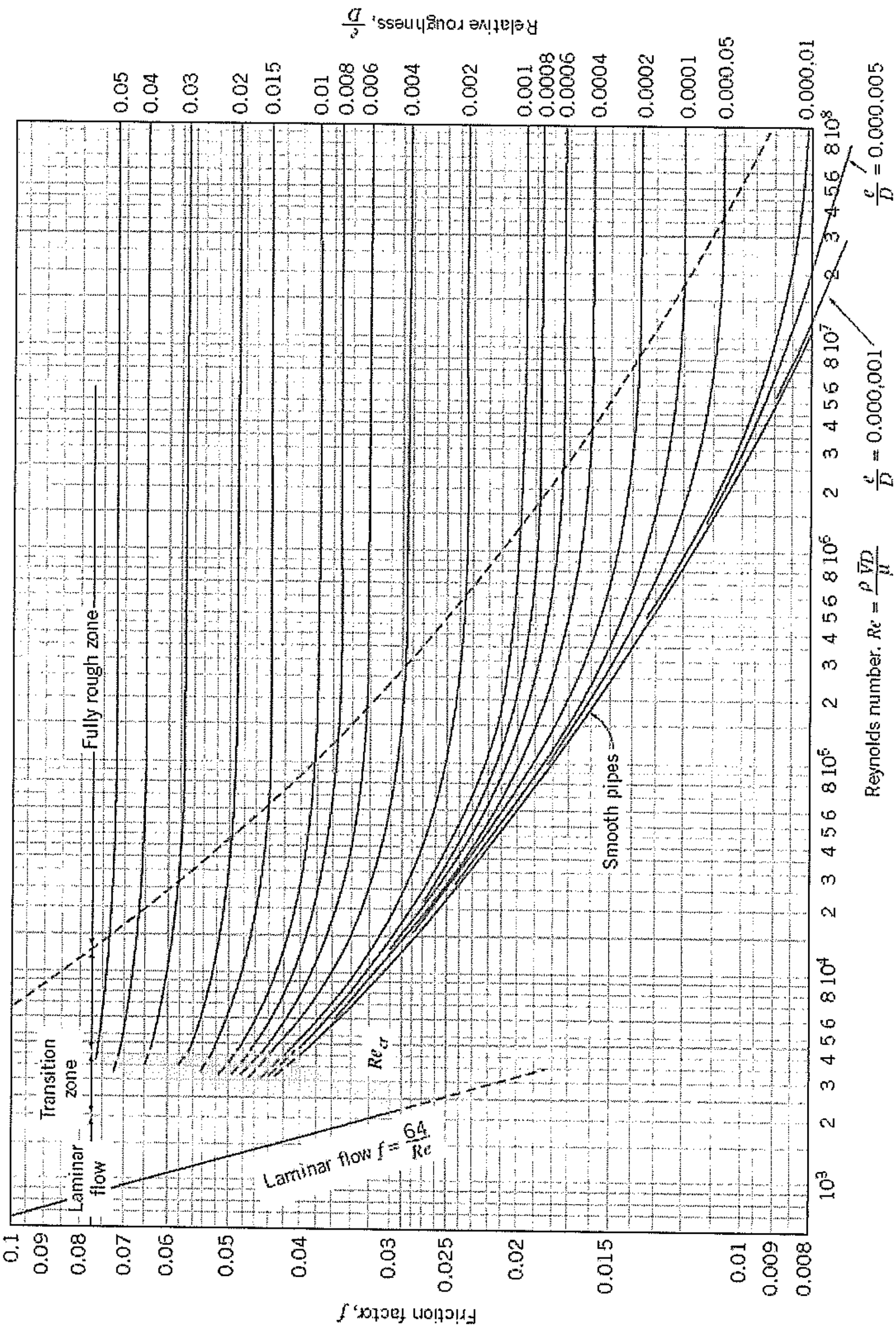
APPENDIX 1: Friction factor for fully developed flow in circular pipes



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APPENDIX 2: Equivalent roughness in circular pipe

	Equivalent Roughness, ε	
Pipe	**Feet**	**Millimeters**
Riveted steel	0.003–0.03	0.9–9.0
Concrete	0.001–0.01	0.3–3.0
Wood stave	0.0006–0.003	0.18–0.9
Cast iron	0.00085	0.26
Galvanized iron	0.0005	0.15
Commercial steel or wrought iron	0.00015	0.045
Drawn tubing	0.000005	0.0015
Plastic, glass	0.0 (smooth)	0.0 (smooth)

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